	A	B	C	D	E	F	G
1				**Flight Requirements**			
2	**Title**	**Background**	**Justification for Space Flight & Experiment Description**	**Orbit**	**Altitude**	**Inclination**	**Correlative Environment Measurements**
3	Low energy electron interaction cross sections and transport algorithms	Nearly all the energy from ionizing radiation is deposited in microelectronics by low-energy secondary electrons. However, the data collection on the interaction cross sections and transport of low-energy electrons has not kept up with the reductions in feature size and improvements in capabilities. These data are needed to improve the transport codes for heavy ions, protons, electrons, and photons that are critical	Perform an experiment in space to collect data, because the ionizing radiation environment in space cannot be replicated on the ground. The experiment should include measurements of the environment and the radiation effects so they can be correlated with the calculated fluence, track-structure or microdosimetric results.	Any	Any	Any	Fluence with differential in energy and angle
4	Electron/positron data and transport in the plasma environment	The transport codes for ionizing radiation do not account for the space and time variations in the space environment due to the lack of data on basic interaction cross sections.	Measure electron/positron data in the space environment and use it to improve the transport tools for the plasma environment.	Any	Any	Any	Low energy charged electron density and temperature
5	Optical and thermal coatings	New optical and thermal coatings have been developed and qualified to the extent possible on the ground. The performance of these coatings needs to be validated in space to retire risk of using materials that are not validated for use in space.	Perform a space experiment to characterize the performance of the coatings as a function of changes in solar activity. The experiment should include calorimeters to measure thermal radiative properties, reflectance, and transmittance.	Any	Any	Any	Ultraviolet, atomic oxygen, charged particles, and thermal
6	Flight validation of ground test protocol for conductive, charge mitigating materials	Conductive materials can be utilized for charge mitigation on spacecraft but their electrical and mechanical properties that are affected by space exposure need to be understood. These properties cannot be accurately measured on the ground, because the space environment cannot be replicated on the ground. A ground test protocol has been developed for these materials, but its reliability will be questioned until it can be validated using data from space.	Perform a space experiment to characterize the performance of candidate conductive, charge mitigating materials. The experiment should include exposure to the space environment, power, data telemetry, and in-situ measurement capability for electrical and mechanical properties.	Any	Any	Any	UV, AO, charged particles, and thermal
7	Durability of microelectromechanical systems (MEMS)	MEMS devices will be sensitive to radiation exposure, but no data have been taken in space. A ground test can be performed to estimate a device's radiation tolerance; however, the test protocol has not been validated with space data and the radiation environment in space cannot be replicated on the ground.	Perform a space experiment to characterize the performance of MEMS devices in the radiation environment. Use the data to validate the ground test protocol. The experiment should be mounted either on the exterior or on the interior of the testbed and will require power and data telemetry.				
8	Performance of inorganic strain gauges	In the past, construction of strain gauges consisted of laminated or thin film metallization on organic substrates that are adhesively bonded to the structures being monitored. A new inorganic material can now be directly deposited on stainless steel structures. This allows the strain sensor to be integrated with the structure with much better adhesion and no outgassing. The performance of the new gauges needs to be characterized in the space environment.	Perform a space experiment to characterize the performance of the inorganic stain gauges. Use the data to reduce the design margins for using this technology.	Any	Any	Any	UV, AO, charged particles, and thermal
9	Fiber optic coating and shielding materials	Optical fiber has single event effects in the space radiation environment. Metallic and polymeric materials continue to be examined as coating and shielding materials for the optical fiber, but no evaluations of their performances in the space environment have been undertaken. Space environment data are needed, because the space ionizing radiation environment cannot be replicated on the ground.	Metallic and polymeric materials that are candidates for coatings and shielding materials for optical fiber should be exposed to the space environment with the fiber in a powered mode so that environment effects can be characterized as functions of time and solar variability. These data will be used to optimize the development of appropriate coatings and shieldings and to validate a ground test protocol.				

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1				Flight Requirements			
2	**Title**	**Background**	**Justification for Space Flight & Experiment Description**	**Orbit**	**Altitude**	**Inclination**	**Correlative Environment Measurements**
10	Applications of nano-scale materials for spacecraft shielding	Nano-scale structures promise to have more strength, enhanced electrical and thermal properties, capability for radiation shielding, and tolerance to space environment effects. However, these materials have not been characterized in space or on the ground. Both types of characterizations are needed to reduce risk of first use in missions.	Perform a space experiment to characterize the performances of the materials. In situ testing of both radiation shielding properties and material degradation are needed to maximize the risk reduction.	Any			
11	Implementation of variable emissivity coating for thermal control using MEMS assembly	Adaptive thermal coatings will be crucial for small spacecraft due to their small power and mass budgets. One proposed technology is variable emissivity coatings for spacecraft radiators. However, its performance in the space environment has not been characterized and is needed to reduce design margins and retire risk.	A space experiment will be performed to characterize the performance of the variable emissivity coatings. Requirements for the space experiment are: a MEMS device; radiation-hard electronic components for operation of MEMS device; temperature sensors to detect temperature changes; and a variable emissivity coating.	Molinya	~200km apogee-35,780km perigee		
12	Bare die shielding of micro spring electronics	Micro-spring electronics is flip chip technology that uses micro springs to provide an electrical interface and mitigation of thermal mismatch and mechanical loads. Rear-side encapsulation of the bare die will provide low-mass total integrated dose (TID) protection. The integration of TID shielding with thermally and mechanically rugged bare die will provide miniature, low-mass electronics for demanding space environments. Flight validation is needed.	Perform a space experiment to characterize the performance of the micro spring electronic devices in the radiation environment. Components of the experiment are power, support electronics, and data telemetry.	GEO, MEO			Total dose monitoring
13	Optimized encapsulating shields for commercial off-the-shelf electronic devices	Encapsulating total integrated dose (TID) shielding of electronic devices has been developed to replace the TID shield over-coated encapsulation. This new concept also provides for charge dissipation, EMI shielding, and thermal conductivity. This is a key enabler of space flight application of state-of-the-art commercial off-the-shelf electronics, but its performance has not been characterized in the space environment.	Perform a space experiment to characterize the performance of the encapsulating TID shielding with a variety of devices. Components of the experiment are power, support electronics , and telemetry.	MEO, GEO			Total dose monitoring
14	Evaluation of annealable TID film	Traditional dosimetry films are "one-time" applications that provide sensitivity only at the beginning of exposure and are non-recoverable. New film concepts are thermally annealable in situ and thus may be renewable with high sensitivity and applicable for long-term exposures. If these new films were used in a space experiment, the could potentially provide a capability to monitor short-term fluctuations in the radiation environment for very long periods of time in space.	A space experiment to flight validate the new films is required before they will be used in missions. Components of the experiment are: (1) control of the thermal environment for annealing; (2) optical sensing heads for film reading; (3) housing for films; (4) analog readout; (5) analog-to-digital conversion of the optical readings; (6) storage of readings; and (7) data telemetry.	GEO, MEO, Planetary	No information at this time	No information at this time	Accompanying dosimetry
15	Validation of a latch up prediction code	Some ionizing radiation transport codes include the equations for modeling latch-up in microelectronics based upon the interpretation of the radiation-induced conductive breakdown of materials. However, results from the code have not been validated with space data, so they cannot provide a reliable prediction of latch up rates in electronic devices in the space radiation environment.	An experiment will be performed in space to measure latch up rates in silicon-based electronic devices during active mode operations as a function of exposure time in the ionizing radiation environment. The space environment is required, because the environment cannot be reproduced on the ground.	GEO, MEO, planetary			Dose and particle monitoring

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16	Real time atomic oxygen measurement	A direct measurement capability for atomic oxygen would improve material degradation studies, but this capability is not available at the present time. One way to measure of atomic oxygen density is to react it with NO2 and then detect the photons emitted at about 440 nm as a product of the reaction, but this technique has not been validated in the space environment.	Perform a space experiment to validate the capability to directly measure atomic oxygen by measuring its product from a reaction with NO2. Components of the experiment are a visible emission spectrometer and a delivery system for NO2.	LEO			All solar environments